International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD)
ISSN(P): 2249-6866; ISSN(E): 2249-7978
Vol. 4, Issue 4, Aug 2014, 101-110

AN ANALYSIS OF THE REGISTERED CDM PROJECTS IN INDIAN FERTILISER INDUSTRY

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ABSTRACT

Advancement of the industrial sector of a country has a close linkage with its economic growth. But in spite of technological developments that have taken place, industrial growth still has its impact on environment. The clean development mechanism (CDM) is one of the three flexible mechanism developed under the Kyoto Protocol of UNFCCC to control green house gas emission through project implementation in developing countries, creating offset credits titled Certified Emission Reductions (CER) for meting the emission reduction targets in developed (Annex-1) countries. CER - refers to one Ton of Carbon Dioxide ($CO_{2)}$ equivalent avoided in a CDM project. CDM has seen a remarkable rise of activity all over the world, since 2006 that has led to more than 5500 registered project submissions by December 2012 with a combined estimated emission reduction volume of 580 million tonnes CO2 eq. During this period, there are 30 registered CDM projects in India, from fertilizer Industry with an annual emission reduction potential of 2.9 Million tonnes CO2 eq. This paper focuses on analyzing all the 30 registered CDM projects from Indian fertilizer industry on the basis of the green house gases associated, project type, project size, crediting period, base-line methodology, sector in fertiliser industry etc. Interaction with major stakeholders like industry, consultant, DoE etc. through interviews and discussions have contributed substantially in the data analysis part.

KEYWORDS: Green House Gases, Kyoto Protocol, Fertilizer Industry, CDM, Carbon Credits

INTRODUCTION

Climate change represents one of the most domineering environmental concerns of our time. Even though there are different viewpoints on this issue, the detection of significant changes in the weather and climatic conditions over the last 100 years, and the attribution of these changes to anthropogenic (manmade) emissions of greenhouse gases (GHGs), has now been accepted by the majority of the scientific community in the world. Scientists predict a dramatic acceleration in Global warming mainly due to the exhaustion of natural carbon sinks and due to the Feedback loops that increase the atmospheric GHG levels. The rapid growth in the world population has imposed increasing pressure on the quantum of food needs of society. Since the scope of increasing the arable land is minimal, increasing the yield per hectare is the only way to meet the food demands of a growing population and the Fertilizer industry has to step in and play a key role for the benefit of society. Considering the total fertilizer production, India is positioned third in the world and for fertilizer consumption, India is second in the world (Fertiliser Statistics 2012-13).

This paper analyzes the CDM projects registered under Indian Fertilizer industry. In order to explore the subject, it is chosen to analyse a database built through 30 Project Design Documents (PDD - approved by the United Nations

Framework Convention for Climate Change) of fertiliser industry associated registered CDM projects in India till December 2012(cdm.unfccc.int/Projects/projsearch.html). This database has provided a homogeneous data for the analysis of fertilizer industry related CDM projects. Official websites of UNFCCC, cdmindia, and the interaction with major stakeholders like industry, consultant, DoE etc. through interviews and discussions were also contributed substantially in the data analysis part. CDM opportunities in the fertilizer application and agriculture front are not coming under the scope of this paper.

UNFCCC & Kyoto Protocol

The research into literature on global initiatives to control climate change highlight the importance of Inter-governmental panel for Climate Change (IPCC) & United Nations Framework Convention for Climate Change (UNFCCC). The international initiative called UNFCCC was adopted in Rio- Earth summit in 1992, with a primary objective to stabilize GHG concentration in the atmosphere that would reduce interference with climate system. Kyoto Protocol was presented at the third conference of UNFCCC nations at Kyoto (COP- 3), Japan on 11th December 1997 and entered into force on February 16th, 2005. Kyoto Protocol set a 'common but differentiated target' of 5.2% reduction in GHG emissions for industrialised countries (called Annex-1 countries including West and Eastern Europe, North America, Japan, New Zealand, Australia) from 1990 levels to be achieved within a five year period between 2008 to 2012 and voluntary participation of developing countries (called Non-Annex I countries like India, Nepal, Chile, Mexico, Botswana, Brazil). Three flexible mechanisms were developed under the Kyoto Protocol of United Nations Framework Convention for Climate Change (UNFCCC) to control climate change (Juha Siikamäki et al, 2012). Under the CDM, an industrialized country having a binding emission reduction target, with technology for reduction of emissions of Green house gases can invest in projects both reducing GHG emissions and contributing to the sustainable development in Non-Annex I countries, can claim credit for the reduction in emission that the project achieves. Annex I country receives CERs and Non-Annex I country receives revenues from CERs (one CER refers to one Ton of CO_2 equivalent avoided in a CDM project). (CDM Rule Book) Greenhouse gases considered under CDM include carbon dioxide, methane, nitrous oxide; hydroflurocarbons, perflurocarbons, sulphur hexafluoride etc and each gas has different warming potential and it is conventional to express all gas emissions in "equivalent amounts of carbon dioxide" (CO2e). (Report of the working group - CDM in India, 2003)

Fertiliser Industry in India

Chemical Fertilizers have played a vital role in the success of India's Green revolution. Though India rank low in comparison to most of developing and some of developed countries in terms of intensity of fertilizer consumption (Nutrient application per hectare), it is positioned third highest in the world in over all fertilizer production and second in overall consumption. There are a total of 152 fertilizer plants engaged in the manufacture of a wide range of fertilizers (Fertiliser Statistics 2012-13). Of these, 30 units produce urea, 19 units produce di-ammonium phosphate (DAP) and complex fertilizers, 1 Calcium Ammonium Nitrate, 1 Ammonium Chloride and 10 units manufacture ammonium sulphate as by-product. Besides these, there are 91 medium and small-scale fertilizer units engaged in the manufacturing of SSP.

Table 1: Rank of India in Fertiliser Production and Consumption

	PRODUCTION (N + P2O5)			CONSUMPTION (N+P2O5+K2O)		
COUNTRY	CHINA	USA	INDIA	CHINA	INDIA	USA
FERTILISER PRODUCTION (in Million MT)	56.6	22.2	16.7	50.5	27.8	20.4
RANK	RANK 1	RANK 2	RANK 3	RANK 1	RANK 2	RANK 3

Source: Fertiliser Statistics 2012-'13

POTENTIAL CDM SECTORS UNDER FERTILIZER INDUSTRY

Major CDM potential areas in fertilizer industry include Fuel and feedstock switch, Energy efficiency improvement, waste heat recovery, N_2O abatement, process gas recovery etc. Development of Renewable Energy Sources (Hydro, Wind, Solar, Biomass), better waste management schemes etc also are implemented as associated activities of the industry.

Green House Gases Associated with Fertilizer Production

Greenhouse gases are produced as a result of numerous industrial processes (Kongshaug, G. 1998). In fertilizer industry, greenhouse gas (GHG) emissions are primarily associated with three industrial processes: Ammonia production, Phosphoric acid production and Nitric acid production. Raw material, intermediate & product handling and effluent treatment are the other areas contributing to GHG emission. Increasing energy costs coupled with the emphasis on GHG reduction has led fertilizer industry to focus on cleaner, energy efficient and sustainable processes.

Table 2: Major Sources of GHG Generation in Fertiliser Manufacture

		Activity	Associated GHG
1	Production (Manufacturing)	Manufacturing process	CO2 (Ammonia production), N2O (Nitric Acid production) etc
		Energy requirement	CO2 (directly & indirectly from energy sourses).
		Auxiliary facilities	CO2 (Energy for Auxiliary facilities)
2	Raw Material Handling	Storage, Handling and Transportation of Raw materials	CO2 (Energy for Handling and Transportation)
3	Intermediates and finished product handling	Storage, Handling and Transportation of Intermediates and finished products	CO2 (Energy for Handling and Transportation)
4	Pollution control / Effluent treatment facilities	Pollution control facilities	CO2(Energy) / Methane (Biological treatment)
5	Associated captive power plants	Captive power for critical units like Ammonia production	CO2 (Power generation)

Based on the results of IFA's latest benchmarking exercise 6 and global fertilizer production statistics for 2007, the fertilizer industry's manufacturing activities generated about 465 Tg CO2-eq in 2007. This represents about 0.93% of global GHG emissions. In comparison, the emissions assigned to the industry in the IPCC Fourth Assessment Report were 410 Tg CO2-eq. Here, about 20% of the products and intermediates manufactured by the fertilizer industry in 2007 were intended for industrial uses. (Bellarby etal. 2008 and IFA production statistics for 2007).

Major Initiatives for Emission Reduction in Indin Fertilizer Industry

There are 30 registered CDM projects (upto December 2012) coming under the scope of Indian fertilizer industry with a total annual Certified emission reduction of 2.9 Million CERs. These projects can be grouped under five different project categories viz Energy efficiency, N2O abatement, Fuel/Feed stock changeover, Process gas recovery and Renewable energy.

- **Energy Efficiency Improvement Projects:** There are 10 fertilizer CDM projects registered under this category with an impact of 0.39 Million annual CERs. Out of this, 9 projects are directly linked with Ammonia- Urea production. Major scope for energy efficiency improvement in Ammonia Plant include upgradation of primary reformer, modifications in steam super heater, condensate stripper, CO_2 removal system, synthesis convertor, compressors, turbines etc. Lowering the energy requirement for production of Ammonia is one of the major factors that control the emission of GHG from Fertiliser Industry as Ammonia production covers more than 80% of energy requirement in Fertiliser Industry. As a thumb rule, energy efficiency improvement of 1 G Cal in ammonia production can roughly translates to a CO_2 reduction of 0.2 MT.

Waste heat recovery projects, utilizing the flue gases for preheating the feed / fuel / combustion air in ammonia plant form another part of the energy efficiency improvement scheme. Utilization of the waste heat for power generation is also an opportunity being developed in this field.

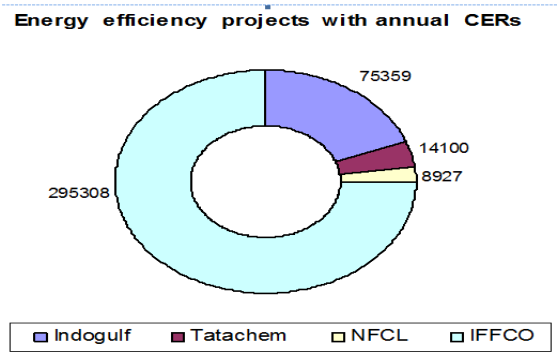

Figure 1: Energy Efficiency CDM Projects with Annual CER Generation

Base line methodologies used in energy efficiency improvement projects are AM 18, AMS IIB and AMS IID. Among the Indian fertilizer industries implemented energy efficiency related CDM projects, Indo Gulf and Tata Chemicals are the major players with five and three registered projects respectively. IFFCO and NFCL also have one project each. Of these, IFFCO's project through revamp of Ammonia plant was the most successful and maximum CER generating potential among them.

- **Process Gas Recovery Projects:** Carbon Dioxide Recovery options to collect CO_2 from flue gases exiting from reformer stack to meet process requirements are implemented for minimizing the CO_2 being vented to the atmosphere through stack. Methane capture from waste streams for fuel supplementation also comes under this category. There are two projects registered under this category and the total emission reduction achieved is comparatively low at 0.017 Million annual CERs. AMS III D is the base line methodology used in both the process gas recovery projects.

- **Feed / Fuel Switch:** Three projects are registered in this category with an annual emission reduction potential of 0.24 Million CERs. All the three projects are focusing on shifting from liquid fuels (Naphtha / furnace Oil) to less carbon intensive Natural gas. Base line methodology used in the registered Feed /fuel switch projects are AM 0008, ACM 0009 and AMS III Q.
- **N2O Abatement Projects:** N2O abatement projects are the most successful CDM projects registered under fertilizer industry, during the first commitment period. There are 7 projects under this category with an annual emission reduction potential of 2.07 Million CERs (which comes to about 71% of the annual CERs from fertilizer industry). The comparatively higher warming potential of N2O and availability of established base line methodologies suitable for the Indian nitric acid industry are the major factors contributing to this achievement. Baseline methodology used in N2O abatement projects are AM 0034 and AM 0019.
- **Renewable Energy Projects:** These are the CDM projects implemented by fertilizer industry for the utilization of renewable energy sources. There are 8 projects grouped under this category and all these projects are wind power projects with a total annual CER generation of 0.2 Million CERs. Gujrat State Fertiliser Company (GSFC) is the leader in this group with 6 wind projects at different locations having a total capacity of 0.16 Million CERs.

BASE LINE METHODOLOGIES USED IN FERTILISER CDM PROJECTS

Table 3: Consolidation of Different Baseline Methodologies Used in Major Fertiliser CDM Projects

Project Type	GHG Associated	Baseline Methodology	Number of Registered CDM Projects
Energy efficiency	CO2	AMS II D AMS II B AM 0018	10
N2O abatement	N2O	AM 0034 ACM 0019	7
Process gas recovery	CH4, CO2	AMS IIID	2
Feed / Fuel switching	CO2	AM 0008 ACM0009 AMS IIIQ	3
Wind energy	CO2	AMS I D ACM 0002	8

SECTOR WISE ANALYSIS OF CDM PROJECTS IN FERTILIZER INDUSTRY

Nitrogenous Fertilizer Sector

Major industries coming under Nitrogenous sector are Ammonia- Urea, Ammonium Sulphate, Ammonium Chloride, Calcium Ammonium Nitrate(CAN) etc. Nitrogenous fertilizer production is highly energy intensive and is one of the largest consumers of petroleum-based Feedstock & fuels. Of these, production of ammonia is the highest energy intensive process in fertilizer manufacturing, it accounts for more than 80% of the energy consumption in the manufacturing processes of a variety of final fertilizer products. Ammonia and Nitric acid are considered as the building blocks of Nitrogenous Fertilisers. Nitrogenous industry covers about 93% of the annual CERs generated by Fertiliser Industry. The high share of CDM projects for Nitrogenous industry is mainly on account of the N2O abatement projects and fuel and feedstock change projects.

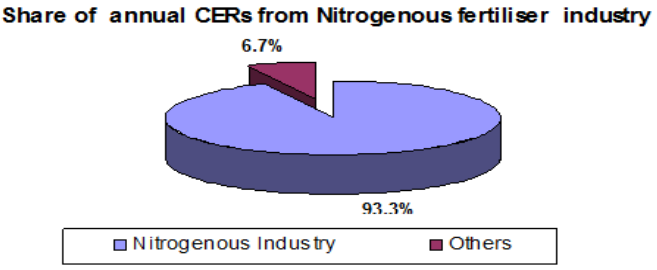

Figure 2: Share of Annual CERs from Nitrogenous Fertilizer Industry

Phosphatic Fertilizer Sector

Major products coming under Phosphatic fertilizer industry are Di Ammonium Phospahe (DAP), Single Super Phospahate, Complex fertilizers of different grades etc. In comparison with Nitrogenous fertilizer industry, production of phosphatic fertilizers has become energy and greenhouse gas neutral to a considerable extent, largely due to energy cogeneration during Sulphuric acid production which can offset the emissions to a large extent from steam and energy usage. The CO2 associated with the Ammonia usage will be comparatively low as most of the Ammonia production is linked with Urea manufacture where the CO2 generated are consumed in the process.

Consolidation of Indian Fertiliser CDM Projects on the Basis of 'CER' Generation

Of the fertilizer industry associated CDM projects registered till december 2012, N2O abatement is the most successful sector in terms of annual CER generation with 7 projects and 70.8% of total CERs. Energy efficiency has the maximum number of 10 projects and has the second largest CER base with 13.4% of the total share. Feedstock change to cleaner sources comes next with 8.3% share. Off gas recovery projects are having a minor share of 0.6% of CER base. Wind projects done as a part of greening the energy base in fertilizer industry comes next with 8 projects and a share of 6.9%. This share may go up in the near future as more wind projects are coming up as a part of utilizing the renewable energy.

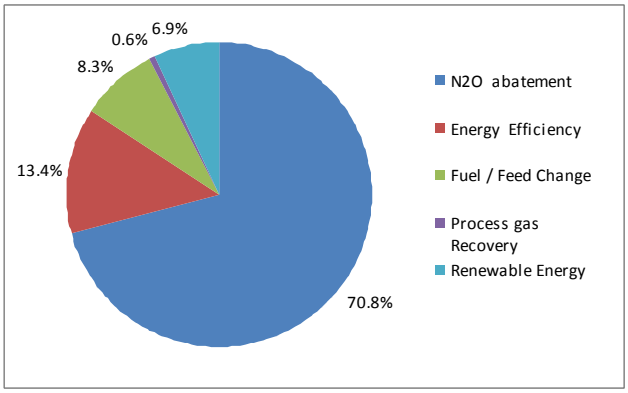

Figure 3: Indian Fertilizer CDM Projects on the Basis of Annual CER Generation

Crediting Period

Crediting period for CDM projects come under two categories. Credit generation for 7 years period (CP-7: renewable) or 10 years period (CP-10: not renewable). A CP-7, corresponds to a 7 years period of credit generating, renewable for a maximum of further two 7 year periods, subject to validation. At the end of each crediting period, the emission reduction levels are reassessed. Under CP-10 option there is no provision for extending the crediting period.

The uncertainty that binds the project to the future of the host country is the major factor that influence the selection of crediting period. Of the 30 registered CDM projects, only 3 are having a crediting period of 7 years (renewable) and the remaining 27 projects are having a crediting period of 10 years (non renewable). This is a clear indication on the uncertainty of CDM mechanism in the post 2012 scenario.

Scale of Projects

CDM projects are classified as Large scale and Small scale depending on the magnitude of emission reductions achieved. Projects classified as Small scale (Fenhann, J, 2003; Sam Wood et al 2004) are falling under three categories viz: renewable energy project activities with a maximum output capacity equivalent to up to 15 megawatts, energy efficiency improvement project activities on the supply and/or demand side, up to the equivalent of 60 gigawatt hours per year and other project activities that both reduce anthropogenic emissions by sources and directly emit less than 60 kilotonnes of carbon dioxide equivalent annually. Projects registered as small-scale CDM projects are entitled to use the simplified modalities and procedures for small-scale CDM project activities set out in 4/CMP.1, Annex II.

Out of the total 30 registered projects, 13 are registered as Large scale and 17 as small scale projects. The 13 large scale projects cover about 93% of the total annual emission reductions. On a category wise analysis, it can be seen that all the N2O abatement projects are registered as Large scale projects and the process gas recovery projects as small scale. About 70% of the energy efficiency projects and 87% of the renewable energy projects belong to small scale category

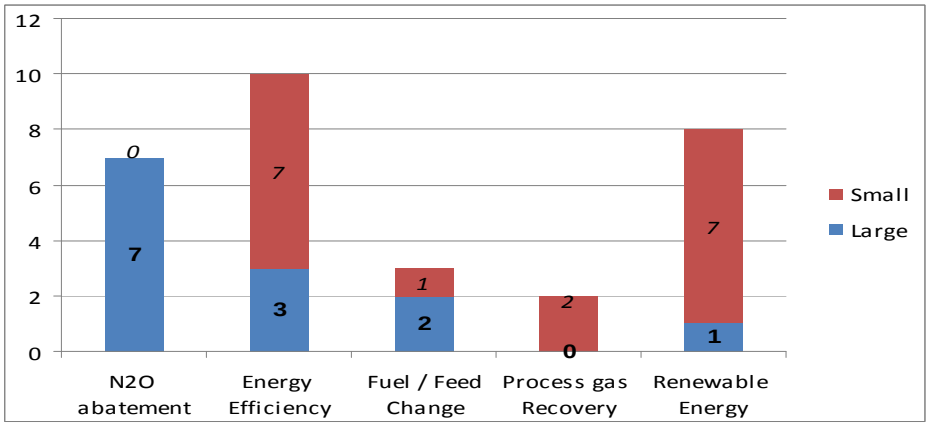

Figure 4: Fertilizer CDM Projects Based on the Size & Category

Type of Industry

Indian fertilizer industry can be broadly classified into Central Public Sector Enterprises (CPSEs), Cooperatives and Private Sector companies. CPSEs are under the administrative control of Central Government. It can be seen that the implementation of CDM is more successful under Private sector considering the number of successful projects. More than 87% of the fertilizer CDM projects, including all the renewable energy projects and process gas recovery projects have come from private sector. But when comparing the annual CERs the scenario is different with more than 62% of the annual CERs coming under the CPSE & Cooperative category. This is mainly on account of the large scale N2O abatement projects and fuel & feedstock change projects registered by CPSEs and Cooperatives. It is also interesting to note that all small scale CDM projects were registered by Private sector companies.

Distribution of Fertiliser CDM Projects during First Commitment Period

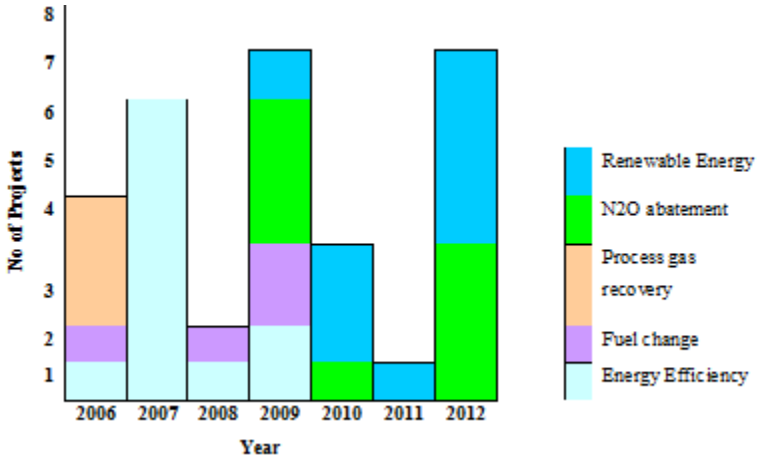

Figure 5: Distribution of Registration of Fertilizer CDM Projects

The number and type of projects registered over the years show that focus was given to areas of energy efficiency, fuel /feed change and process gas recovery during the initial years of CDM implementation. N2O abatement and Renewable energy came into focus in the following years. Annual emission reductions increased from a below 0.1 Million CER level for projects registered in 2006 and reached a peak level of 1.7 Million CER during 2009. High emission reductions were achieved mainly on account of the Large scale N2O abatement projects.

POST 2012 SCENARIO

By the end of 2012, the market price of CER has fallen significantly to a range of below one Euro. Post-2012 prices in the CER market remain fragmented, with the value depending on the project location and the methodology it uses. Improvement in the CER market price is a must for the future of CDM concept. The 18th session of the Conference of the Parties to the UNFCCC held at Doha, Qatar during November – December 2012, (Doha Climate gateway) has decided on a second commitment period of eight years during 2013 to 2020 with a plan to review on CDM rules. The countries who have joined for the second commitment period have a contribution of 15% in global GHG emissions. Canada, Japan, Russia and New Zealand opted out of this option. As a part of the National Action Plan for Climate Change (NAPCC), a Perform Achieve and Trade (PAT) scheme is implemented in 2012, for 8 sectors of energy intensive industries covering about 500 industries in India (PAT consultation document, 2011). Under this scheme industries are given a specific target for reduction from the present energy consumption levels and penalty is fixed for non compliance. Fertiliser sector also is falling under PAT scheme where the specific energy levels for Urea production are considered as the target for control. A 4.27% improvement from the 2007 level is planned for Urea industry by the year 2015. This is a clear indication that energy efficiency improvement is a focus area in Indian nitrogenous fertilizer sector for post 2012 scenario.

CONCLUSIONS

CDM can be considered as an effective tool to complement national and regional regulatory frameworks to encourage the mitigation of Green House Gases. The concept CDM has played a role in bringing the industrial focus in reducing the GHG emission from fertilizer sector. CDM potential areas in fertilizer industry include Fuel and feedstock switch, Energy efficiency, waste heat recovery, N_2O abatement, process gas recovery and utilization of renewable energy.

Through 30 registered CDM projects, Indian fertilizer industry has an annual GHG reduction potential of about 2.93 Million CERs.

CDM in the present circumstances may be considered as a transitional tool of international climate co-operation. India's initiative towards sustainable Development is well defined in the implementation of National Action Plan for Climate Change where Solar energy and energy efficiency improvement are the two areas focused with emission mitigation outlook. Implementation of PAT scheme focusing energy efficiency improvement in eight energy intensive industrial sectors is a major initiative in this regard. Sustainable Development has been identified as a compulsory parameter in the performance MOU for all public sector undertakings under Government of India. Specific energy consumption for production of all major fertilizers has been declining due to employing superior processes and switching over to cleaner feed stocks and fuel. Improved control systems, implementation of Quality Management Systems and Environment Management Systems have considerably improved the working environment and minimized the environmental impact. With the completion of the first commitment period and uncertainties regarding the follow up plan, CDM market is unsteady at present. Decision regarding the second commitment period from 2013 to 2020 taken in the COP 18 at Doha and its follow up action plan in COP 19 [12] in fixing a timeline to secure a new international climate agreement at COP 21 in Paris in 2015 is expected to improve the situation.

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